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EXTRACTING ASSOCIATION RULES BASED ON INTUITIONISTIC FUZZY SETS

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Abstract. *Association rules play an important role in data mining. Nowadays, there are many approaches to extract association rules from information systems or large databases, in which, confidence degrees are widely used to evaluate association rules. Based on intuitionistic fuzzy sets, we propose a new approach to extract association rules. The approach consists of the intuitionistic fuzzy set representations of association rules, new confidence degrees of association rules and a discrete bi-level parametric programming. The intuitionistic fuzzy set representations of association rules are based on three kinds of knowledge bases: pattern knowledge, antecedent knowledge and succedent knowledge. Base on the three knowledge bases, we can obtain type-1, type-2 and type-3 A-IFS representations of association rules. Based on similarity measure between two A-IFSs and OWA operator, a new confidence degree is proposed to evaluate every association rule. Numerical examples show that our confidence degrees provide more information about association rules than the existed confidence degrees. To generate association rules from an information system automatically, a discrete bi-level parametric programming is discussed in this paper. By using the discrete bi-level parametric programming, generating association rules become easier, an numerical example shows that our method is useful.*

Keywords: Association rule, Intuitionistic fuzzy sets, OWA operator, Confidence degree, Discrete Bi-level parametric programming

1. **Introduction.** Intuitionistic fuzzy sets (A-IFSs) introduced by Atanassov [1, 2, 3, 4] is a powerful tool to deal with uncertainty. Although a purely mathematical terminological debate about "intuitionistic" of A-IFSs is recently raised [5, 13], the A-IFSs theory has been investigated by many researches and applied to various fields [10, 11, 12, 24, 25, 30, 33]. Formally, an A-IFS is $A = \{(x, \mu_A(x), \nu_A(x))|x \in X\}$, where $\mu_A(x)$ and $\nu_A(x)$ are the degree of membership and the degree of non-membership of the element $x \in X$ to the set $A \subseteq X$ such that for every $x \in X$, $0 \leq \mu_A(x) + \nu_A(x) \leq 1$, the value $\pi_A(x) = 1 - \mu_A(x) - \nu_A(x)(\forall x \in X)$ is called the degree of indeterminacy of x to A [1], or an intuitionistic index of x in A [27]. It has been shown that A-IFSs are L-fuzzy sets with respect to the complete lattice $(L, \leq_L)$, in which, $L = \{(x_1, x_2) \in [0,1] \times [0,1]|x_1 + x_2 \leq 1\}$, and for any $(a_1, a_2), (b_1, b_2) \in L$, $(a_1, a_2) \leq_L (b_1, b_2)$ if and only if $a_1 \leq b_1$ and $a_2 \geq b_2$ [9, 29]. Although an A-IFS is equivalent to others mathematical structure, *e.g.*, L-fuzzy set or interval-valued fuzzy set, however, the A-IFS is different from others from practical point of view. In A-IFSs, experts concentrate on advantages and disadvantages, pros and cons